

Pollen Morphology of the Genera *Dendrolobium* and *Phyllodium* (*Leguminosae: Papilionoideae* Tribe *Desmodieae*)

Bin YE^a, Hiroyoshi OHASHI^{a,*} and Kazuaki OHASHI^b

^a Herbarium TUS, Botanical Garden, Tohoku University, Sendai, Miyagi, 980-0862 JAPAN;

^b School of Pharmacy, Iwate Medical University, Yahaba, Iwate, 028-3694 JAPAN

* Corresponding author: ohashi@m.tohoku.ac.jp

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Pollen grains of nine species of *Dendrolobium* and four of *Phyllodium* were described and illustrated based on observations by scanning (SEM) and transmission (TEM) electron microscopy in order to add new pollen characters to existing data provided by LM observations. The pollen grains of the two genera are fundamentally similar in morphology of the pollen type, sculpture of the exine, structure of the colpus, and structure of the exine, but show differences in shape and membrane of the colpus and thickness of the sexine. The results suggested closer relationships between these genera than previously considered.

Key words: *Dendrolobium*, *Desmodieae*, exine structure, *Leguminosae*, *Phyllodium*, pollen grains, pollen morphology, SEM, TEM.

Dendrolobium and *Phyllodium* belong to tribe *Desmodieae* of *Leguminosae: Papilionoideae* (Ohashi et al. 1981, Ohashi 2005). Ohashi (1973) inferred their close relationship based on morphology and structure of the inflorescence, flowers and pollen grains. Pedley (1999) indicated similarity between the two genera in having fasciculate flowers subtended by foliage leaves or modified foliage leaves in contrast with other genera of the tribe in having inflorescences subtended by stipule-like bracts (primary bracts). The two genera are members of the *Phyllodium* group of tribe *Desmodieae* based on results of an analysis of the chloroplast gene *rbcl* (Ohashi 2005). They are distinct from the *Desmodium* group and the *Lespedeza* group (Ohashi 2005).

The pollen morphology and structure of *Dendrolobium* and *Phyllodium* were first

examined by Ohashi (1973) for the taxonomic study of *Desmodium* and its allied genera. He recorded pollen grains of 10 species of *Dendrolobium* and eight species of *Phyllodium* based on observation by light microscopy (LM), and showed that the pollen morphology is new evidence of the two genera as distinct from *Desmodium* in a broad circumscription which included the two genera as infrageneric taxa (Bentham 1865, etc.). Ohashi (1997a, 1997b, 1998a, 1998b) and Ohashi et al. (1999) examined pollen morphology as one of the characters to find further species of *Dendrolobium* among *Desmodium* then known.

Dendrolobium comprises 18 species of which nine are distributed in Indo-China (9 spp.), Malesia to Australia (6 spp.), and India (2 spp.) through Myanmar (4 spp.), China (5 spp.) to Japan (1 sp.) (Ohashi 2005). Most of the

species of the genus occur in rather narrow areas except the following two species. *Dendrolobium umbellatum* (L.) Benth. is a seashore plant in Asia, Africa and Australia of which fruits are widely spread by currents, and *D. triangulare* (Retz.) Schindl. is widely distributed in Asia growing usually on hillsides from Sri Lanka and India in the west to Taiwan in the east.

Phyllodium contains eight species centered in Myanmar, Thailand and Indo-China (Ohashi 2005). Most of the species are confined in these areas similar to the distribution pattern of *Dendrolobium*. *Phyllodium pulchellum* (L.) Desv. is the only species in the genus widely distributed, in SE to E Asia and N Australia.

This paper provides descriptions and electron micrographs of pollen grains of nine species of *Dendrolobium* and four of *Phyllodium* based on observations by scanning (SEM) and transmission (TEM) electron microscopy. Species examined are *Dendrolobium arbuscula* (Domin) H. Ohashi, *D. cumingianum* Benth., *D. dispersum* (Hayata) Schindl., *D. lanceolatum* (Dunn) Schindl., *D. papuacola* H. Ohashi & T. Nemoto, *D. polyneurum* (S. T. Blake) H. Ohashi, *D. stipatum* S. T. Blake, *D. triangulare* (Retz.) Schindl., *D. umbellatum* (L.) Benth., *Phyllodium elegans* (Lour.) Desv., *P. longipes* (Craib) Schindl., *P. pulchellum* (L.) Desv., and *P. vestitum* Benth.

Pollen grains of *Dendrolobium cumingianum* and *D. stipatum* are recorded for the first time. *Dendrolobium lanceolatum*, *Phyllodium elegans*, *P. longipes* and *P. vestitum* are observed for the first time by SEM and TEM, and of *D. triangulare* and *P. pulchellum* first by TEM. Data of *D. arbuscula* and *D. polyneurum* are modified from previous reports (Ohashi 1998, Ohashi et al. 1999). Previous pollen sizes recorded by Ohashi (1973) are larger than the present data in every species examined in this study. The previous data are shown with the description of each species below. The differences would come from pretreatments of pollen grains for observation, not from different specimens.

Material, Method and Terminology

Pollen grains were obtained from herbarium specimens kept in Tohoku University (TUS) as indicated with each description of the species treated in this paper. Pollen data cited from papers published by Ohashi (1973, 1997, 1998) and Ohashi et al. (1999) were based on materials taken from specimens in Arnold Arboretum (A), Forestry Herbarium, Bangkok (BKF), Kyoto University (KYO), University of Tokyo (TI) and Smithsonian Institute (US). Method follows Ye and Ohashi (2002, 2005, 2007). Terminology is based on Punt et al. (1994).

Pollen grains of *Dendrolobium*

Previous records of the pollen grains of *Dendrolobium* observed in LM were made by Ohashi (1973) on the following 10 species: *Dendrolobium dispersum*, *D. lanceolatum*, *D. olivaceum* (Prain) Schindl., *D. quinquepetalum* (Blanco) Schindl., *D. rostratum* (Schindl.) Schindl., *D. rugosum* (Prain) Schindl., *D. thorelii* (Gagnep.) Schindl., *D. triangulare*, *D. umbellatum*, and *D. ursinum* (Schidl.) Schindl. Chen and Huang (1993) examined *D. dispersum*, *D. triangulare*, and *D. umbellatum* by SEM and TEM.

Ohashi (1973, pp. 50–51) described general features of the *Dendrolobium* pollen in LE observation. Additional features are provided here by SEM and TEM observations. Sculpture reticulate occasionally with puncta in lumina; lumina 1–3 μm in diameter at mesocolpium, with free columellate elements. Colpi 0.7–0.8(–0.9) times as long as the polar axis, ca. 1(–3) μm wide at equator, narrowing to pointed or rounded ends; colpus membrane finely granulate. Exine ca. 1–1.5 μm thick; sexine semitectate, usually slightly thicker than the nexine; tectum discontinuous, ca. one third as thick as the exine; infratectum regularly columellate; foot-layer continuous; endexine well developed, ca. one third as thick as the exine, gradually thickening toward colpi.

Other pollen features specific to each species

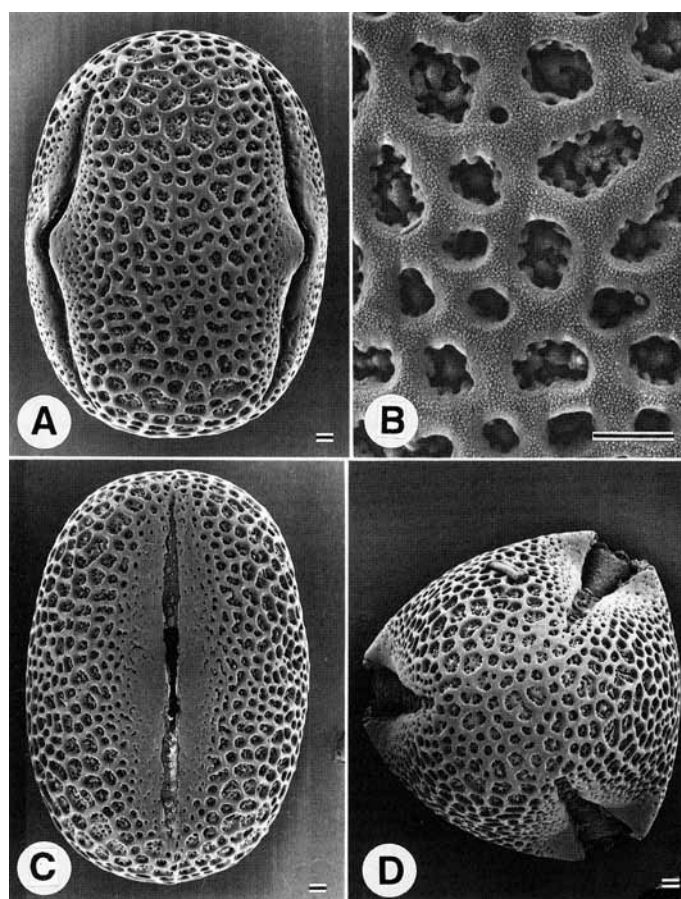


Fig. 1. Pollen of *Dendrolobium arbuscula*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. Scale bar 1 μ m. (reproduced from Ohashi et al. 1999).

are described below:

***Dendrolobium arbuscula* (Domin) H. Ohashi (Fig. 1)**

Pollen grains tricolporate; polar axis (21–)25(–27) μ m, equatorial diameter (16–)19(–20) μ m; P/E = (1.21–)1.34(–1.50), subprolate to prolate, equatorial view elliptic or rectangular-elliptic, polar view semiangular. Lumina 0.8–1.5 μ m in diameter at mesocolpium. Colpus margin continuously tectate; endoaperture 0.2–0.3 times as long as the polar axis.

Voucher specimen: Papua New Guinea. Port Moresby. Brass 8789 (A).

Note: The description and electron micrographs

are modified from Ohashi et al. (1999). Colpi 0.8–0.9 times as long as the polar axis in this species, while 0.7–0.8 times in others examined in this study.

***Dendrolobium cumingianum* Benth.**

(Fig. 2)

Pollen grains tricolporate; polar axis (20.9–)24.2(–28.4) μ m, equatorial diameter (14.6–)16.9(–19.6) μ m, P/E = (1.29–)1.43(–1.64), subprolate to prolate, equatorial view rectangular-elliptic, polar view almost circular. Lumina 1–2.5 μ m in diameter at mesocolpium. Colpi ca. 2 μ m wide at equator; colpus membrane almost smooth; colpus margin

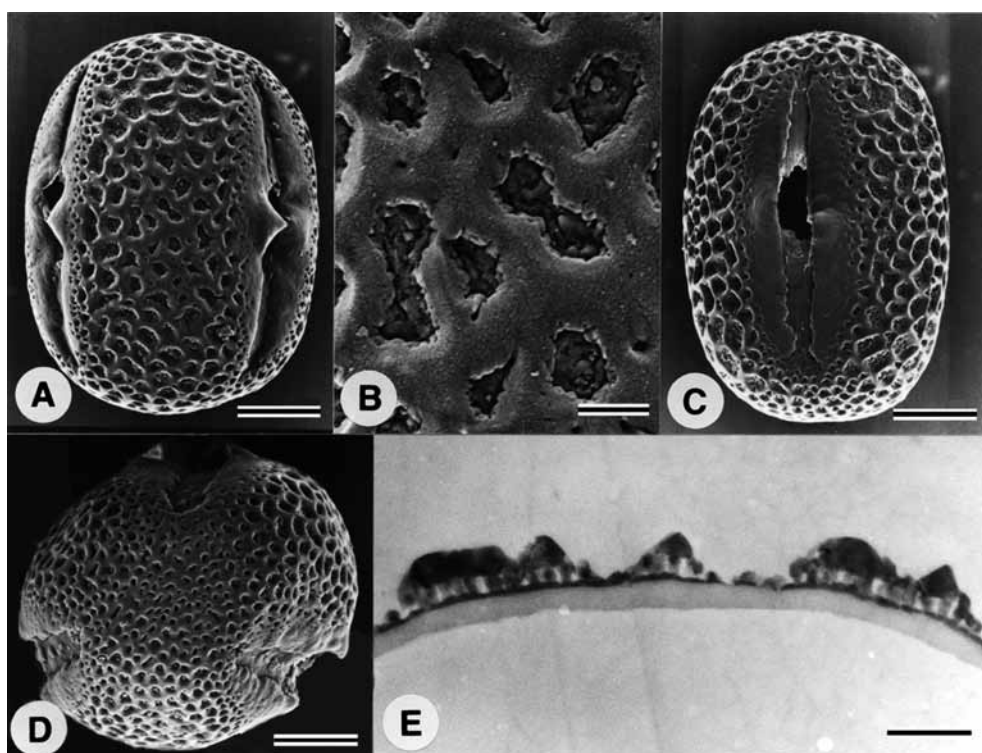


Fig. 2. Pollen of *Dendrolobium cumingianum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. Scale bar: A, C, D = 5 μm ; B, E = 1 μm .

continuously tectate but smaller reticulate at the ends; endoaperture 0.1–0.2 times as long as the polar axis. Exine ca. 1 μm thick in mesocolpium; tectum discontinuous, ca. 1/3 times as thick as the exine; infratectum as thick as the tectum, regularly columellate; foot-layer continuous, ca. 1/2 times as thick as the infratectum; endexine ca. 1/3 times as thick as the exine.

Voucher specimen: Philippines. Luzon. B. S. Ramos 22341 (A).

Note: The colpi of this species are slightly broader than those of other species examined in this study (ca. 1 μm wide), but narrower than *Dendrolobium dispersum* (ca. 3 μm wide). The colpus membrane is almost smooth and the endoaperture 0.1–0.2 times as long as the polar axis, while colpus membranes are finely granulate and the endoaperture 0.2–0.3 times as long as the polar axis in all the other species

examined here. Thus the endoaperture is smaller than those of other species examined in this study having 0.2–0.3 times as long as the polar axis.

Dendrolobium dispersum (Hayata) Schindl. (Fig. 3)

Pollen grains tricolporate; polar axis (18.8–) 20.6(–22.3) μm , equatorial diameter (16.3–) 17.1(–18.4) μm , P/E = (1.08–) 1.21(–1.32), prolate spheroidal to subprolate, equatorial view elliptic, polar view almost circular. Lumina 1–2 μm in diameter at mesocolpium. Colpus margin continuously tectate but smaller reticulate at the ends; endoaperture 0.2–0.3 times as long as the polar axis. Exine 0.8–1 μm thick in mesocolpium, sexine ca. 1.5 times thicker than nexine; tectum almost discontinuous, ca. one third as thick as the exine; infratectum as

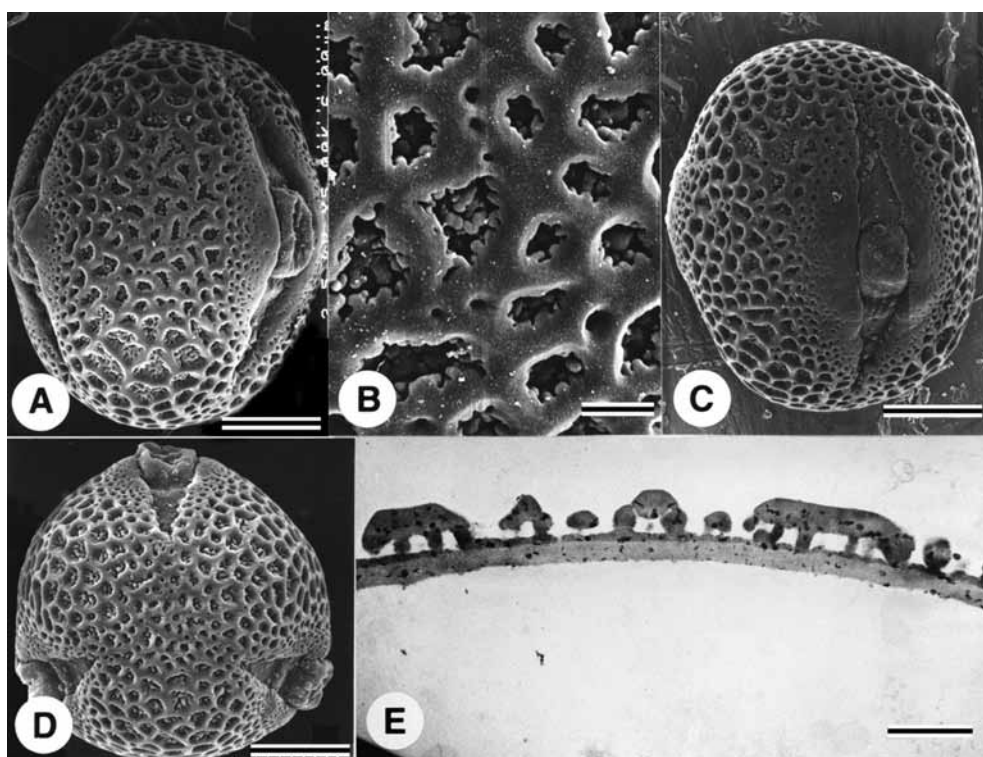


Fig. 3. Pollen of *Dendrolobium dispersum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. Scale bar: A, C, D = 5 µm; B, E = 1 µm.

thick as the tectum, regularly columellate; foot-layer continuous, less than half as thick as the infratectum; endexine ca. one third as thick as the exine.

Voucher specimen: Taiwan. Pingtung Co., Fengkang-Hsinlu. Y. Tateishi & T. Nemoto 20273 (TUS).

Note: Pollen data of this species obtained by LM observation (Ohashi 1973 based on Taiwan: Pingtung Hsien. Chuang 2411. TI) were grain-size $31\text{--}34 \times 22\text{--}25$ (average 32.1×23.0) µm, P/E = 1.28–1.55, prolate or often subprolate, lumina size 2–3 µm in diameter, and exine thickness (ca. 1.5 µm thick). The colpus of *Dendrolobium dispersum* is broader than those of other species examined, being 1–2 µm wide. The sexine of this species is ca. 1.5 times thicker than the nexine, but other species examined here have slightly thicker sexine than the nexine.

Dendrolobium lanceolatum (Dunn) Schindl. (Fig. 4)

Pollen grains tricolporate; polar axis (20.6–)22.6(–25.0) µm, equatorial diameter (15.8–)17.0(–20.8) µm, P/E = (1.09–)1.33(–1.47), prolate spheroidal to subprolate, equatorial view rectangular-elliptic, polar view semiangular. Lumina 1–1.5 µm in diameter at mesocolpium. Colpus margin continuously tectate; endoaperture 0.2–0.3 times as long as the polar axis. Exine ca. 1 µm thick in mesocolpium, tectum discontinuous, ca. one third as thick as the exine; infratectum short, ca. half as thick as the tectum or slightly more, regularly columellate; foot-layer continuous, as thick as the infratectum, thicker than other species examined in this study; endexine ca. one third as thick as the exine.

Voucher specimen: China. Hainan. T. Nemoto & al. 1021014 (TUS).

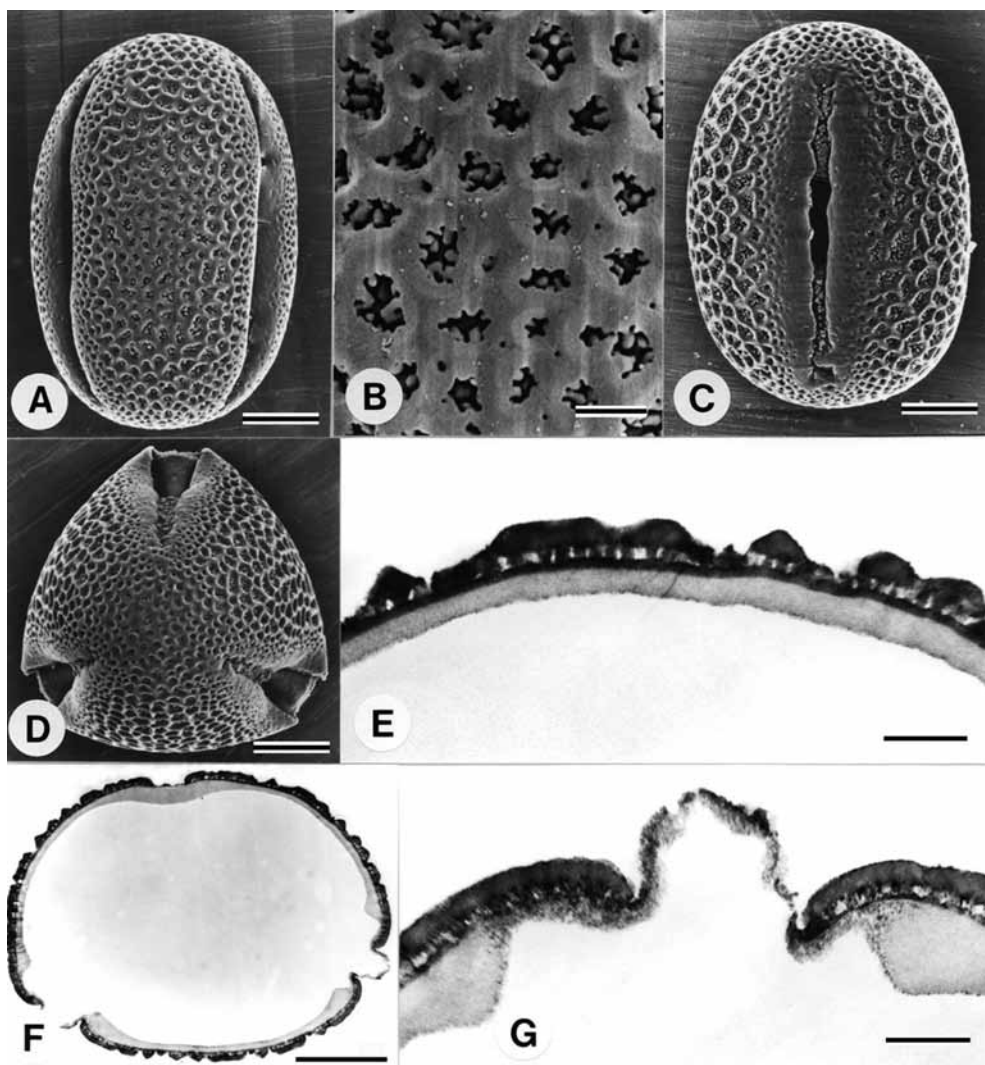


Fig. 4. Pollen of *Dendrolobium lanceolatum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Radial section across aperture. Scale bar: A, C, D, F = 5 μ m; B, E, G = 1 μ m.

Note: Pollen data of this species obtained by LM observation (Ohashi 1973 based on Thailand: Pingtung Loei, Phukrading. Shimizu et al. T.12950. KYO) were as follows: grain-size $30\text{--}36 \times 18\text{--}25$ (average 33.7×22.0) μ m, P/E=1.44–1.67, prolate, and lumina-size 2–3 μ m in diameter. The foot-layer of *Dendrolobium lanceolatum* is thicker than those of other species examined here, having a foot layer ca. half as thick as the infratectum.

Dendrolobium papuacola H. Ohashi & T. Nemoto (Fig. 5)

Pollen grains tricolporate; polar axis (20.6–)22.4(–24.6) μ m, equatorial diameter (14.8–)16.5(–17.9) μ m, P/E = (1.20–)1.36(–1.49), subprolate to prolate, equatorial view rectangular-elliptic, polar view semiangular. Lumina 1–1.5 μ m in diameter at mesocolpium. Colpus membrane finely granulate; endoaperture

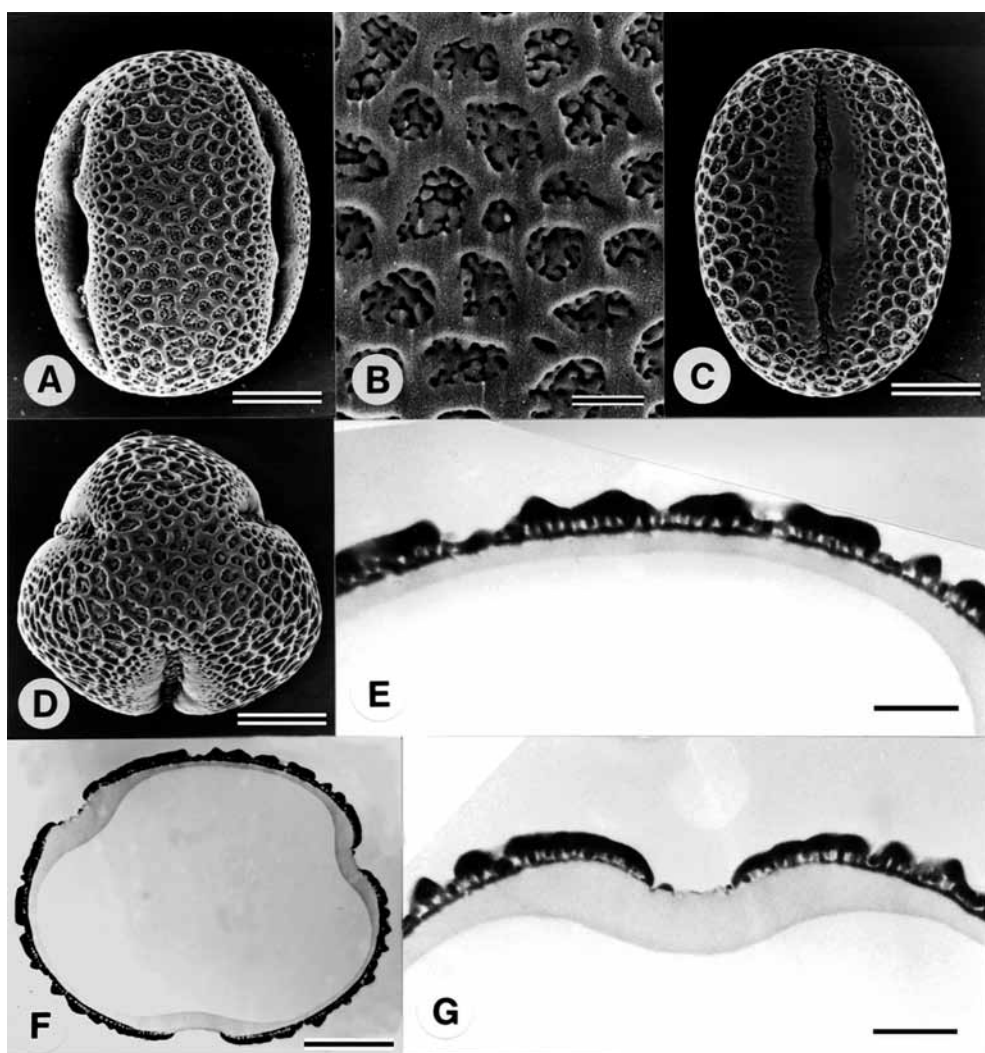


Fig. 5. Pollen of *Dendrolobium papuacola*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Radial section across aperture. Scale bar: A, C, D, F = 5 μ m; B, E, G = 1 μ m.

0.2–0.3 times as long as the polar axis; colpus margin continuously tectate but smaller reticulate at the ends. Exine 0.8–1 μ m thick in mesocolpium; tectum discontinuous, ca. one third as thick as the exine; infratectum ca. half as thick as the tectum or slightly more, regularly columellate; foot-layer continuous, more than half as thick as the infratectum; endexine ca. one third as thick as the exine.

Voucher specimen: New Guinea. Loloki River. L. T. Brass 1654 (A).

Note: Pollen features in SEM observations were modified from the data published by Ohashi et al. (1999).

Dendrolobium polyneurum (S. T. Blake) H. Ohashi (Fig. 6)

Pollen grains tricolporate; polar axis (21–) 22(–25) μ m, equatorial diameter (16–) 17(–18) μ m; P/E = (1.20–) 1.34(–1.47), subprolate to prolate, equatorial view subcircular, polar view semiangular. Lumina irregularly polygonal,

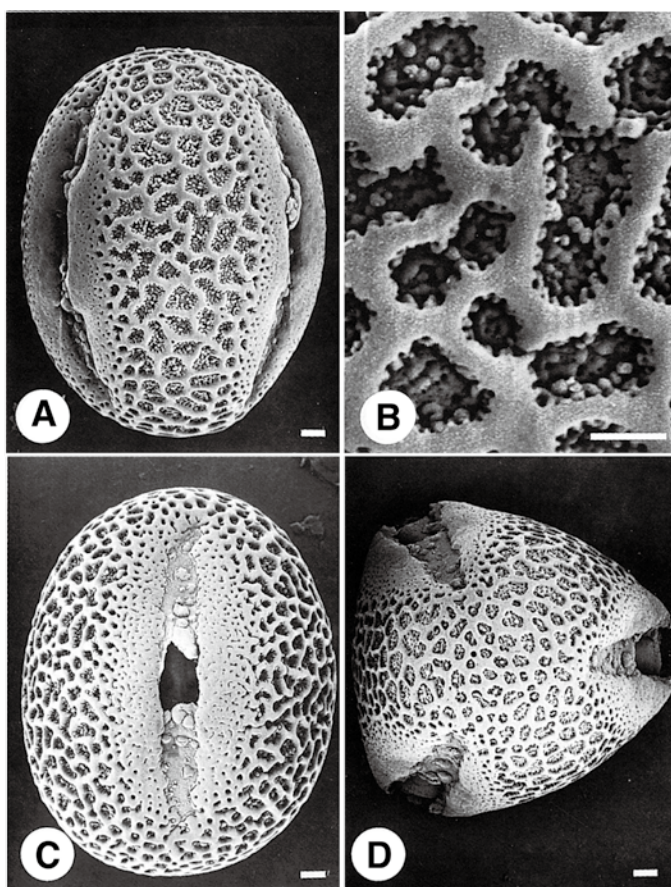


Fig. 6. Pollen of *Dendrolobium polyneurum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. Scale bar = 1 μm . (modified from Ohashi 1998).

1.0–2.5 μm in diameter at mesocolpium. Colpus margins with a complete tectum; endoaperture less than 0.1–0.2 times as long as the polar axis.

Voucher specimen: Australia. Northern Territory. 2.5 miles S. W. of Tipperary Homestead. Erect undershrub 2–3.5 ft. high, with numerous stems from base. Flowers white. 23 July 1961. Lazarides 6677 (US).

Note: The description and electron micrographs modified from the data published by Ohashi (1998).

Dendrolobium stipatum S. T. Blake (Fig. 7)

Pollen grains tricolporate; polar axis (20–)21(–25) μm , equatorial diameter (16–)18(–20) μm ; P/E = (1.04–)1.20(–1.45), prolate spheroidal, subprolate to prolate, equatorial view

subcircular, polar view semiangular. Lumina irregularly polygonal, 0.8–1.2 μm in diameter at mesocolpium. Colpus margins with a complete tectum; endoaperture less than 0.2–0.3 times as long as the polar axis.

Voucher specimen: Australia. July 1946. S. T. Blake 16670 (A).

Dendrolobium triangulare (Retz.) Schindl.
subsp. *triangulare* (Fig. 8)

Pollen grains tricolporate; polar axis (20.5–)23.1(–25.8) μm , equatorial diameter (14.1–)15.8(–18.8) μm , P/E = (1.18–)1.46(–1.65), subprolate to prolate, equatorial view rectangular-elliptic, polar view almost circular.

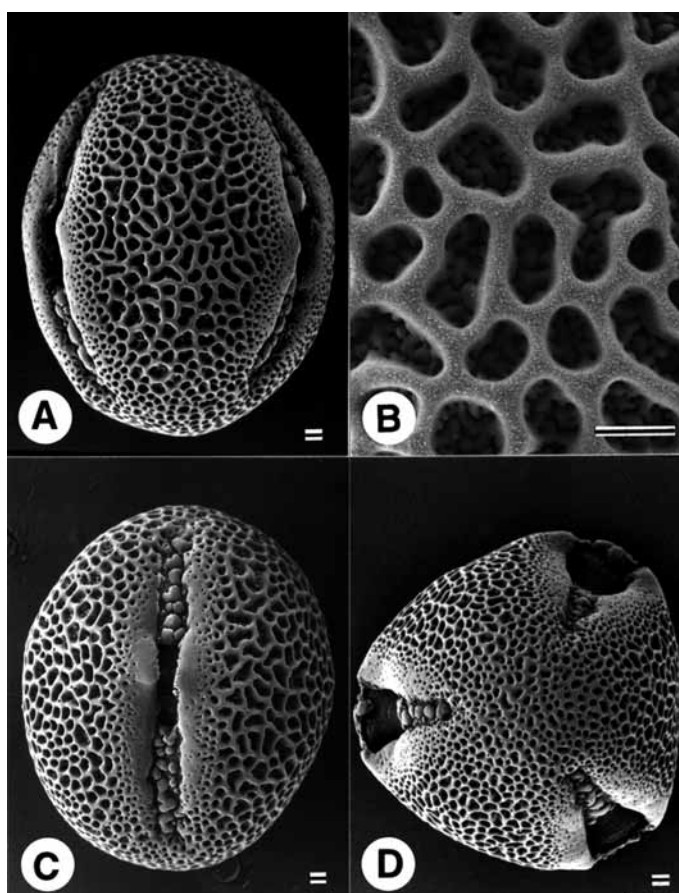


Fig. 7. Pollen of *Dendrolobium stipatum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. Scale bar = 1 μm .

Lumina uniformly ca. 1 μm in diameter at mesocolpium. Colpus margin continuously tectate but smaller reticulate at the ends; endoaperture 0.2–0.3 times as long as the polar axis. Exine 1–1.5 μm thick in mesocolpium; tectum discontinuous, ca. one third as thick as the exine; infratectum ca. half as thick as the tectum, regularly columellate; foot-layer continuous, ca. half as thick as the infratectum; endexine ca. one third as thick as the exine.

Voucher specimen: China, Guangdong, Guangzhou. H. G. Yip 255 (TUS).

Note: Pollen data of *Dendrolobium triangulare* subsp. *triangulare* obtained by LM observation (Ohashi 1973 based on Taiwan.

Pingtung Hsien. Chuang 2411. TI) were grain-size 32–38 \times 19–25 (average 35.4 \times 22.6) μm and lumina 2–3 μm in diameter. The exine of this taxon and *D. umbellatum* is slightly thicker than those of other species examined in this study, at ca. 1 μm thick. The lumen less variable than that of other species examined.

Dendrolobium umbellatum (L.) Benth.

(Fig. 9)

Pollen grains tricolporate; polar axis (21.5–)22.9(–25.0) μm , equatorial diameter (17.1–)18.2(–19.2) μm , P/E = (1.18–)1.28(–1.35), subprolate to prolate, equatorial view rectangular-elliptic, polar view almost circular.

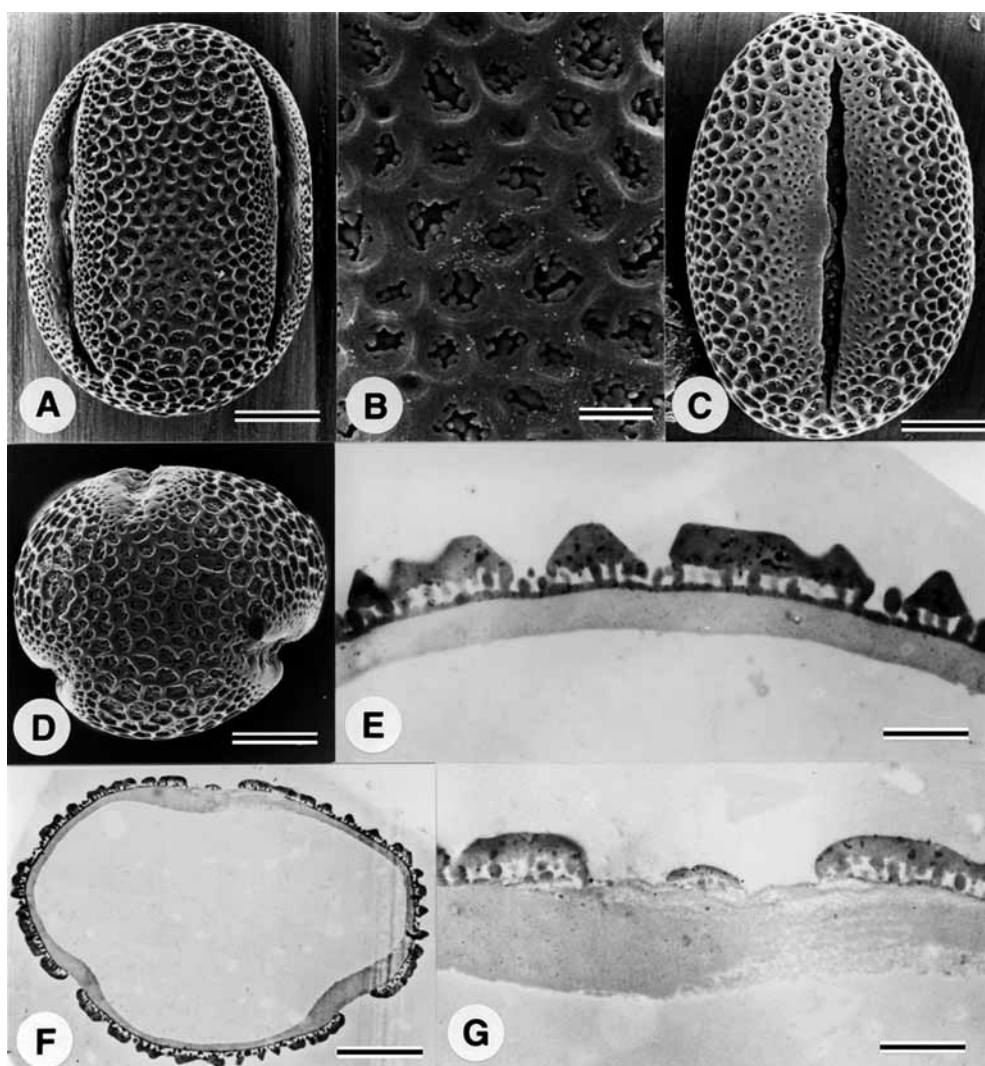


Fig. 8. Pollen of *Dendrolobium triangulare*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 μ m; B, E, G = 1 μ m.

Lumina 1–3 μ m in diameter at mesocolpium. Colpus margin continuously tectate but smaller reticulate at the ends; endoaperture 0.2–0.3 times as long as the polar axis. Exine 1–1.5 μ m thick in mesocolpium; tectum discontinuous, ca. one third as thick as the exine; infratectum as thick as or slightly less than tectum, regularly columellate; foot-layer continuous, ca. half as thick as the infratectum; endexine ca. one third as thick as the exine.

Voucher specimen: Taiwan. Botel Tobago. C. E. Chang 11817 (TUS).

Note: Pollen data of this species obtained by LM observation (Ohashi 1973 based on Singapore. Togashi 622162. TI) were tricolporate or rarely dicolporate; grain-size 24–44 \times 21–35 (average 37.0 \times 27.1) μ m; P/E = 1.11–1.58, prolate, subprolate, or prolate spheroidal; lumina ca. 2.5 μ m in diameter (erroneously as 5 μ m in diameter); and exine 1.5–2 μ m thick. The SEM

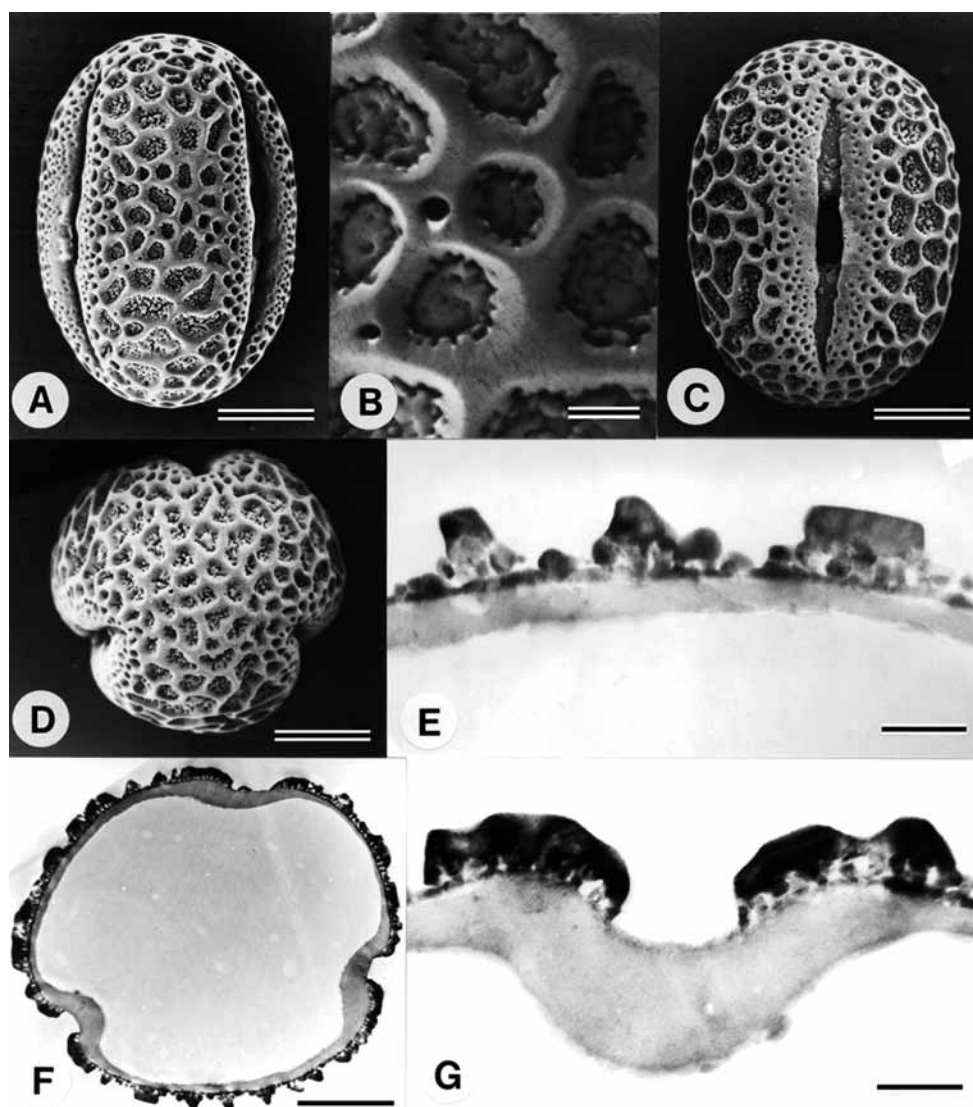


Fig. 9. Pollen of *Dendrolobium umbellatum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 µm; B, E, G = 1 µm.

data and electron micrographs of this species were modified from Ohashi et al. (1999).

Pollen grains of *Phyllodium*

Previous records of the pollen grains of *Phyllodium* were made by Ohashi (1973) in LM observation on the following species: *P. elegans* (Lour.) Desv., *P. insigne* (Prain) Schindl., *P. kurzianum* (Prain) Schindl., *P. longipes* (Craib)

Schindl., *P. pulchellum* (L.) Desv., and *P. vestitum* Benth. Chen and Huang (1993) showed SEM data of *P. pulchellum* from Taiwan.

Ohashi (1973) recognized two subgenera of *Phyllodium* by differences in the lumen size of reticulate sculpture: subgen. *Prainia* only *P. insigne* with lumina more than 10 µm in diameter, while subgen. *Phyllodium* with lumina less than 5 µm in diameter. The two subgenera

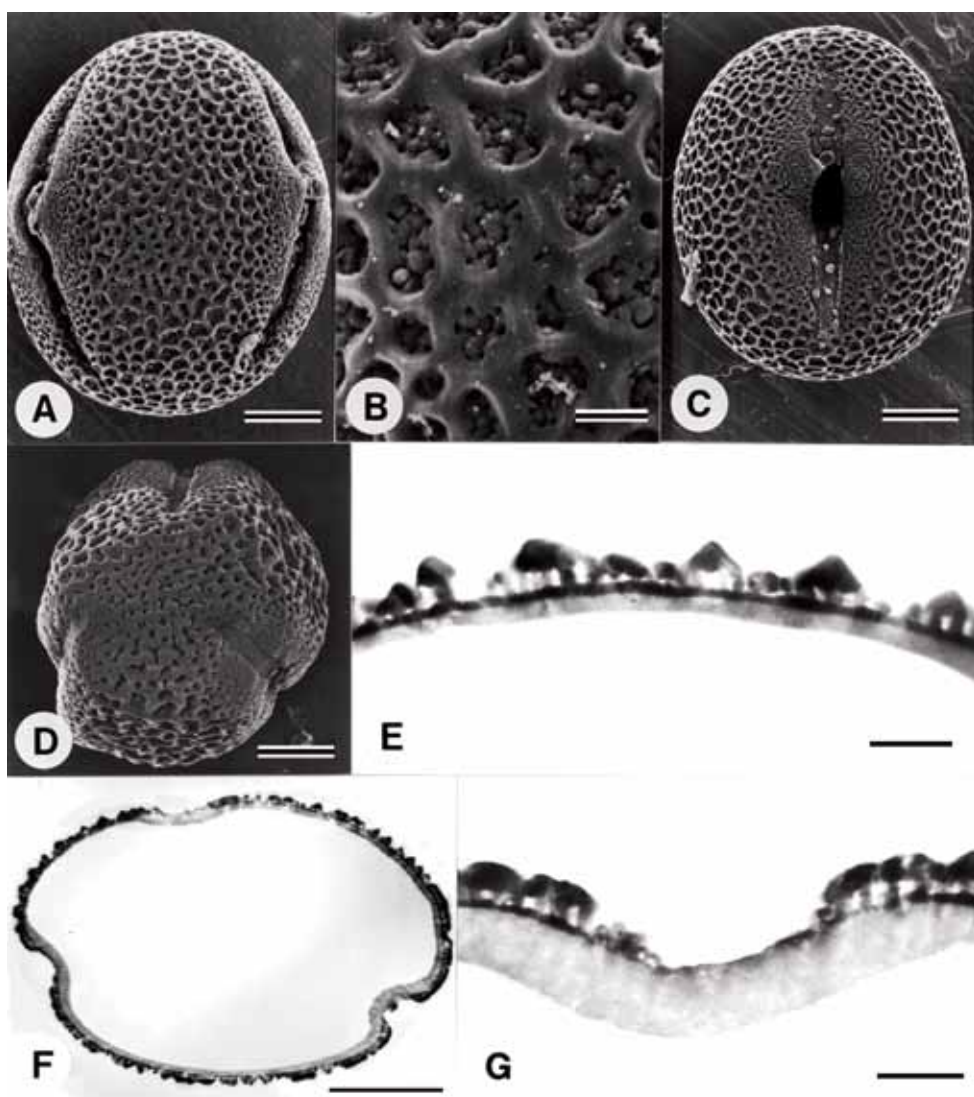


Fig. 10. Pollen of *Phyllodium elegans*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 μ m; B, E, G = 1 μ m.

differ in gross morphology and each of them seems to form a rather distinct natural group. Pedley (1999) ignored the subgenera based on variation of the production of foliar bracts in *Phyllodium hackeri* Pedley, but pollen grains of the species need to be examined.

The general features of pollen grains of *Phyllodium* in LM observations were given by Ohashi (1973). Additional descriptions to

the general features are provided here in SEM and TEM observations: Sculpture reticulate, occasionally with puncta in lumina; lumina 1–3 μ m in diameter at mesocolpium, with columellae elements. Colpi 0.7–0.8 times as long as the polar axis, ca. 2 μ m wide at equator, narrowing to rounded ends, colpus membrane with scattered granules, endoaperture ca. 0.2 times as long as the polar axis. Exine 1–1.5

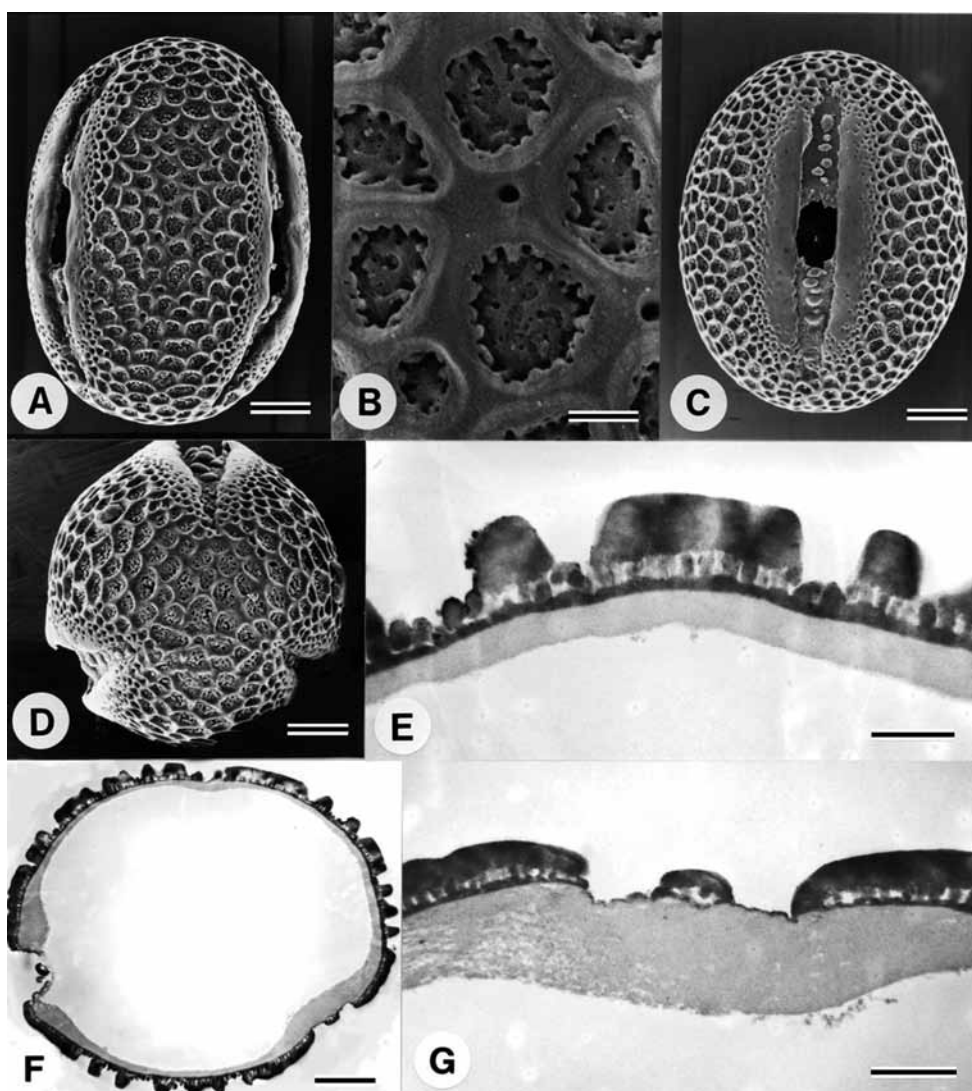


Fig. 11. Pollen of *Phyllodium longipes*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Equatorial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 μm ; B, E, G = 1 μm .

μm thick in mesocolpium; sexine semitectate, thicker than the nexine; tectum discontinuous, ca. one third as thick as the exine; infratectum regularly columellate; foot-layer continuous; endexine well developed, gradually thickening toward colpi.

Phyllodium elegans (Lour.) Desv. (Fig. 10)
Pollen grains tricolporate; polar axis (19.7–)

21.8(–24.1) μm long, equatorial diameter (17.3–) 19.1(–20.3) μm , P/E = (1.06–)1.14(–1.26), prolate spheroidal to subprolate, equatorial view elliptic, polar view almost circular. Lumina 1–1.5 μm in diameter at mesocolpium. Colpus margins with condensed reticulate tecta; endoaperture ca. 0.2 times as long as the polar axis. Exine ca. 1 μm thick in mesocolpium; tectum ca. one third as thick as the exine; infratectum as thick as or

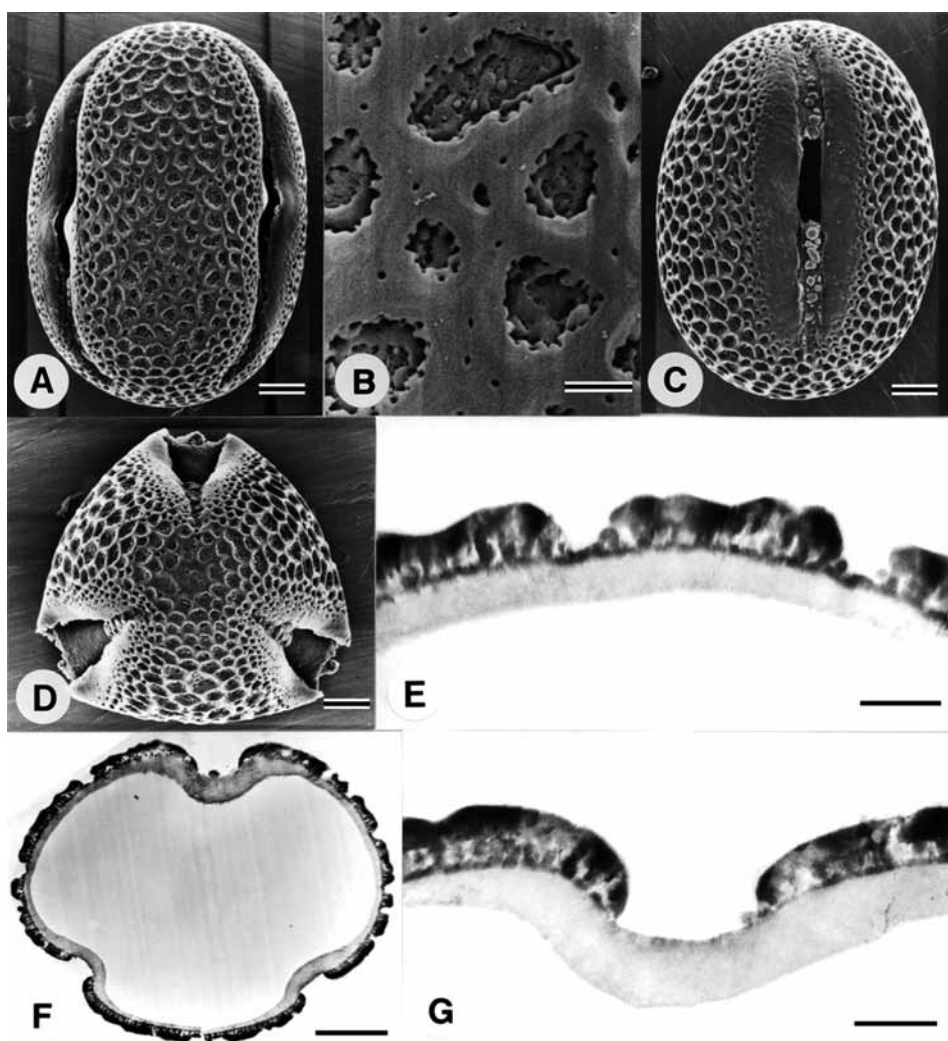


Fig. 12. Pollen of *Phyllodium pulchellum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 μm ; B, E, G = 1 μm .

less than the tectum; foot-layer as thick as or less than the columellae; endexine 1/3–1/4 times as thick as the exine.

Voucher specimen: China, Hainan, Da-la. T. Tuyama & al. 81572 (TUS).

Note: Pollen data of *Phyllodium elegans* obtained by LM observation (Ohashi 1973 based on China. Lei 894. TI) were size 34–40 \times 32–33 (average 36.7 \times 32.3) μm , P/E = 1.06–1.25, lumina (irregularly polygonal, ca. 4 μm in

diameter) and exine (2 μm thick). The colpus margin of this species has a rugulate or punctate tectum (Fig. 7c), but a continuous tectum in the remaining species examined in this study (Figs. 8c, 9c, 10c).

Phyllodium longipes (Craib) Schindl.

(Fig. 11)

Pollen grains tricolporate; polar axis (29.2–)32.1(–33.8) μm , equatorial diameter

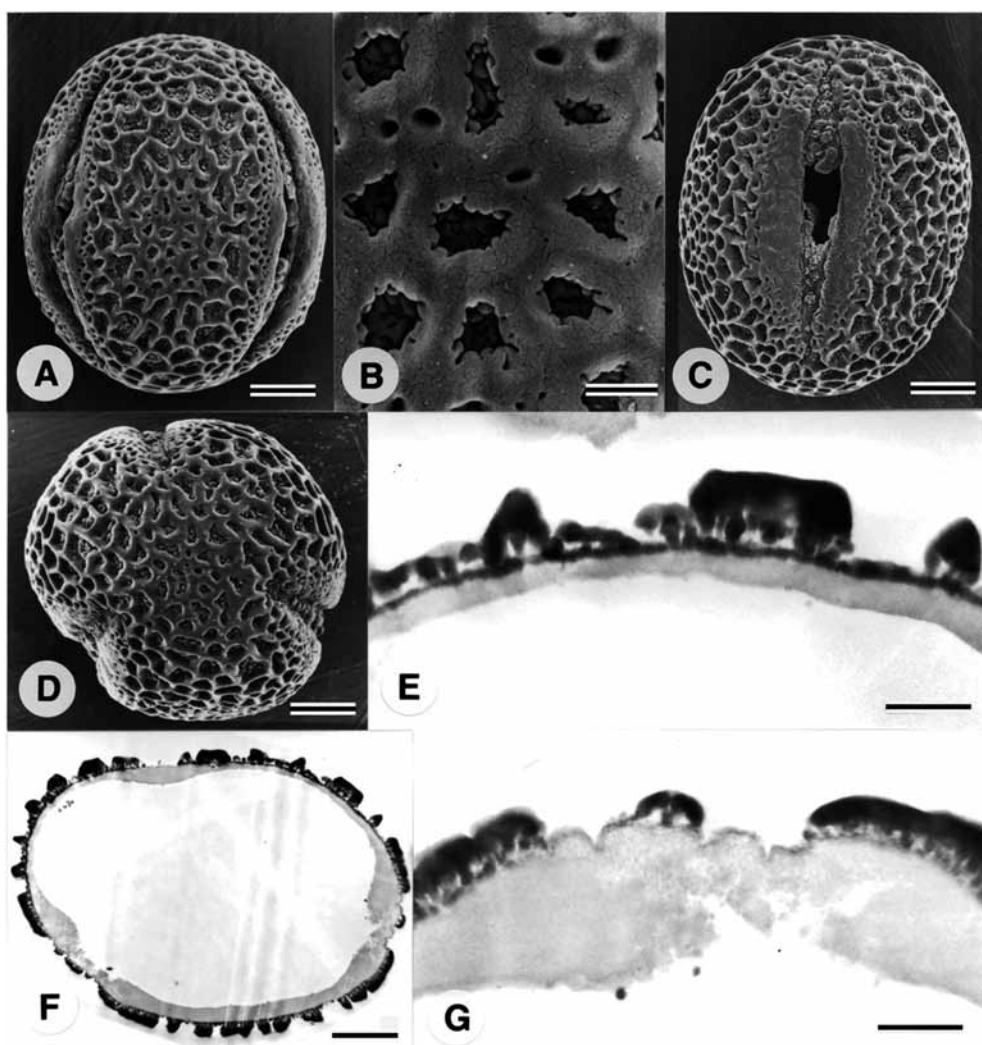


Fig. 13. Pollen of *Phyllodium vestitum*. A. Mesocolpium in equatorial view. B. Lumina at mesocolpium. C. Aperture in equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar: A, C, D, F = 5 μ m; B, E, G = 1 μ m.

(22.1–)23.5(–26.5) μ m, P/E = (1.10–)1.37(–1.51), prolate spheroidal, subprolate or prolate, equatorial view elliptic or rectangular-elliptic, polar view almost circular. Lumina 2–3 μ m in diameter at mesocolpium. Colpus margins with continuous tectum; endoaperture medium, ca. 0.2 times as long as the polar axis. Exine ca. 1.5 μ m thick in mesocolpium; tectum one third to half as thick as the exine; infratectum ca. half as thick as the tectum; foot-layer as thick as or less

than the infratectum; endexine one quarter to one fifth as thick as the exine.

Voucher specimen: Thailand: Muk Dahan. R. Schultze-Kraft & S. Pattanavibul. CIAT-13245 (TUS).

Note: Pollen data of *Phyllodium longipes* obtained by LM observation (Ohashi 1973 based on Thailand. Chiang Mai. Hayata s.n. on 3 Oct. 1921. TI) were as follows: size 25–29 \times 17–28 (average 27.1 \times 19.8) μ m; shape P/E = 1.17–1.65, prolate or often subprolate; lumina

irregularly polygonal with granules, 2–3 μm in diameter, and exine 1.5–2 μm thick. In TEM observation the endexine is thinner than those of others examined in this study.

***Phyllodium pulchellum* (L.) Desv. (Fig. 12)**

Pollen grains tricolporate; polar axis (28.8–)30.5(–31.9) μm , equatorial diameter (20.8–)22.8(–25.0) μm , P/E = (1.23–)1.41(–1.54), subprolate to prolate, equatorial view elliptic or rectangular-elliptic, polar view semiangular. Lumina 1–3 μm in diameter at mesocolpium. Colpus margins with continuous tectum; endoaperture medium, ca. 0.2 the length of polar axis. Exine 1–1.5 μm thick in mesocolpium; tectum ca. 1/3 times as thick as the exine; infratectum ca. 1/2 times as thick as or slightly thicker than the tectum; foot-layer ca. 1/2 times as thick as the infratectum; endexine ca. 1/3 times as thick as the exine.

Voucher specimen: Taiwan. Tainan Co., Wushantou Reservoir. Y. Tateishi & Endo 20857 (TUS).

Note: Pollen data of *Phyllodium pulchellum* obtained by LM observation (Ohashi 1973 based on Thailand. Doi Saket – Me Wou. Hayata s.n. on 28 Oct. 1921. TI) were as follows: tricolporate, size 34–39 \times 22–31 (average 35.6 \times 26.7) μm , P/E = 1.10–1.68, prolate, subprolate or often prolate spheroidal, lumina (3–4 μm in diameter) and exine (ca. 2 μm thick).

***Phyllodium vestitum* Benth. (Fig. 13)**

Pollen grains tricolporate; polar axis (20.6–)24.7(–26.9) μm , equatorial diameter (18.8–)19.8(–21.6) μm , P/E = (1.08–)1.25(–1.37), prolate spheroidal, subprolate to prolate, equatorial view elliptic or rectangular-elliptic, polar view almost circular. Lumina 1–3 μm in diameter at mesocolpium. Colpus margins with continuous tectum but condensed reticulate at the ends. Exine ca. 1.5 μm thick in mesocolpium; tectum ca. one third as thick as the exine; infratectum almost as thick as the tectum; foot-layer ca. half as thick as the infratectum; endexine one quarter to one fifth as thick as the

exine.

Voucher specimen: Thailand: Rauong. T. Santisuk 651 (TUS).

Note: Pollen data of *Phyllodium vestitum* obtained by LM observation (Ohashi 1973 based on Thailand. Chaiyaphum. Phengnaren 267. BKF) are as follows: tricolporate, size (35–41 \times 25–31 (average 38.6 \times 28.7) μm , P/E=1.25–1.46, prolate or subprolate, lumina (ca. 5 μm in diameter) and exine (1.5–2 μm thick).

Similarity and difference between *Dendrolobium* and *Phyllodium*

Similarity of pollen grains of *Dendrolobium* and *Phyllodium* is demonstrated through SEM and TEM observations in this study in addition to the previous work (Ohashi 1973). The pollen grains of the two genera are tricolporate, reticulate; lumina 1–3 μm in diameter at mesocolpium, with free columellate elements. Colpi 0.7–0.8(–0.9) times as long as the polar axis. Exine 1–1.5 μm thick in mesocolpium; sexine semitectate; tectum discontinuous, ca. one third as thick as the exine; infratectum regularly columellate; foot-layer continuous; endexine well developed, ca. one third as thick as the exine, gradually thickening toward colpi.

Differences between the two genera are found in the colpus and sexine. *Dendrolobium* has the colpus narrowing to pointed or rounded ends, whereas *Phyllodium* has that of always has rounded ends; the colpus membrane is microgranulate (or smooth in *D. cumingianum*) and the endoaperture is 0.2–0.3 times (0.1–0.2 times in *D. cumingianum*) as long as the polar axis in *Dendrolobium*, whereas in *Phyllodium* the colpus membrane is granulate and the endoaperture is ca. 0.2 times. The sexine of *Dendrolobium* is slightly thicker than the nexine (except *D. dispersum*), whereas sexine is thicker than the nexine in *Phyllodium*.

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葉 續^a, 大橋広好^a, 大橋一晶^b: マメ科ナハキハギ属
とウチワツナギ属の花粉形態

ナハキハギ属 *Dendrolobium* とウチワツナギ属 *Phyllodium* はマスビトハギ連に分類され、形態、花粉、分子系統の比較によって近縁の属と考えられている (Ohashi 1973, 2005). この2属の花粉はこれまで光学顕微鏡と一部の種についての走査型電子顕微鏡による観察であったため、今回走査型および透過型電子顕微鏡を用いた観察で微細形態と層構造とを補足した。本研究ではナハキハギ属 18 種のうち 9 種、ウチワツナギ属 8 種のうち 4 種の花粉を記録した。両属の花粉は共に三溝孔粒、表面模様は網目型、網目は赤道綫の溝間域 *mesocolpium* で直径約 1–3 μm あり、柱状突起がみられる。溝は花粉粒長軸の 0.7–0.8(–0.9) 倍である。花粉

外壁は赤道綫の溝間域で厚さ 1–1.5 μm 、有刻層 *sexine* は半外表層型 *semitectate*、外表層 *tectum* は不連続、その厚さは外壁の約 1/3 である。柱状層は規則的、底部層 *foot-layer* は連続であり、内層 *endexine* がよく発達し、その厚さは外壁の約 1/3 である。一方、両属の間では発芽溝の末端の形状、膜上の顆粒状突起、内孔の大きさ、有刻層と無刻層 *nexine* の厚さにわずかの差異がある。両属は以上のように花粉の形態と構造において基本的な特色で共通する。これらの点は両属の近縁性を示していると思われる。

(^a 東北大学植物園津田記念館,

^b 岩手医科大学薬学部)